National Aeronautics and Space Administration

Steve Cook
Manager, Ares Projects

American Astronautical Society
Wernher von Braun
Memorial Symposium
October 21, 2008

The Ares Projects: Back to the Future

www.nasa.gov

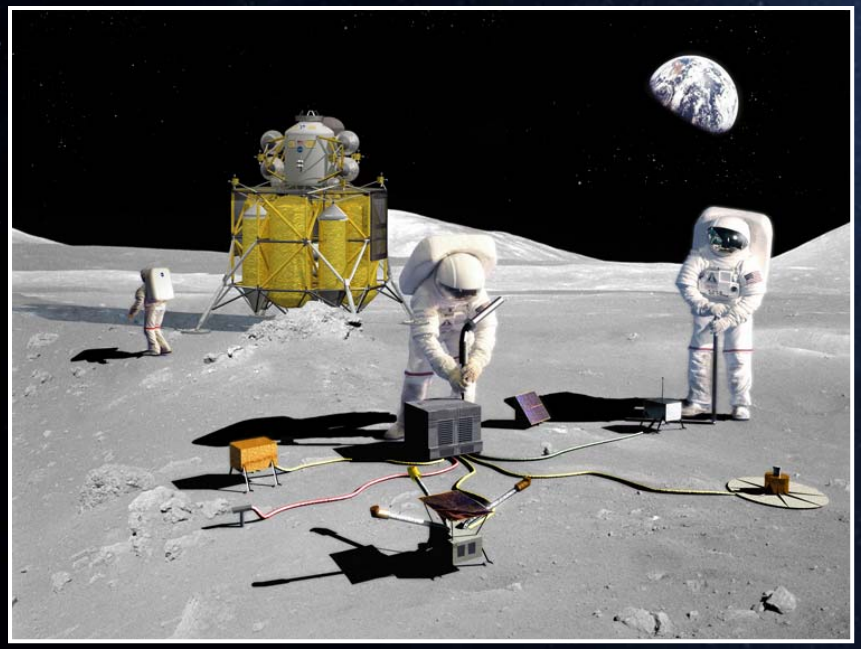
provided by NASA Technical Report
brought to you by
metadata, citation and similar papers at core.ac.uk

Today's Journey

- NASA's mission
- Ares Projects design considerations
- Vehicle overviews
- Ares Projects progress

NASA's Mission

- **Safely fly the Space Shuttle until 2010**
- **Complete the International Space Station (ISS)**
- **Develop a balanced program of science, exploration, and aeronautics**
- **Develop and fly the Orion Crew Exploration Vehicle (CEV)**
  - Designed for exploration but will initially service ISS
- **Land on the Moon no later than 2020**
- **Promote international and commercial participation in exploration**



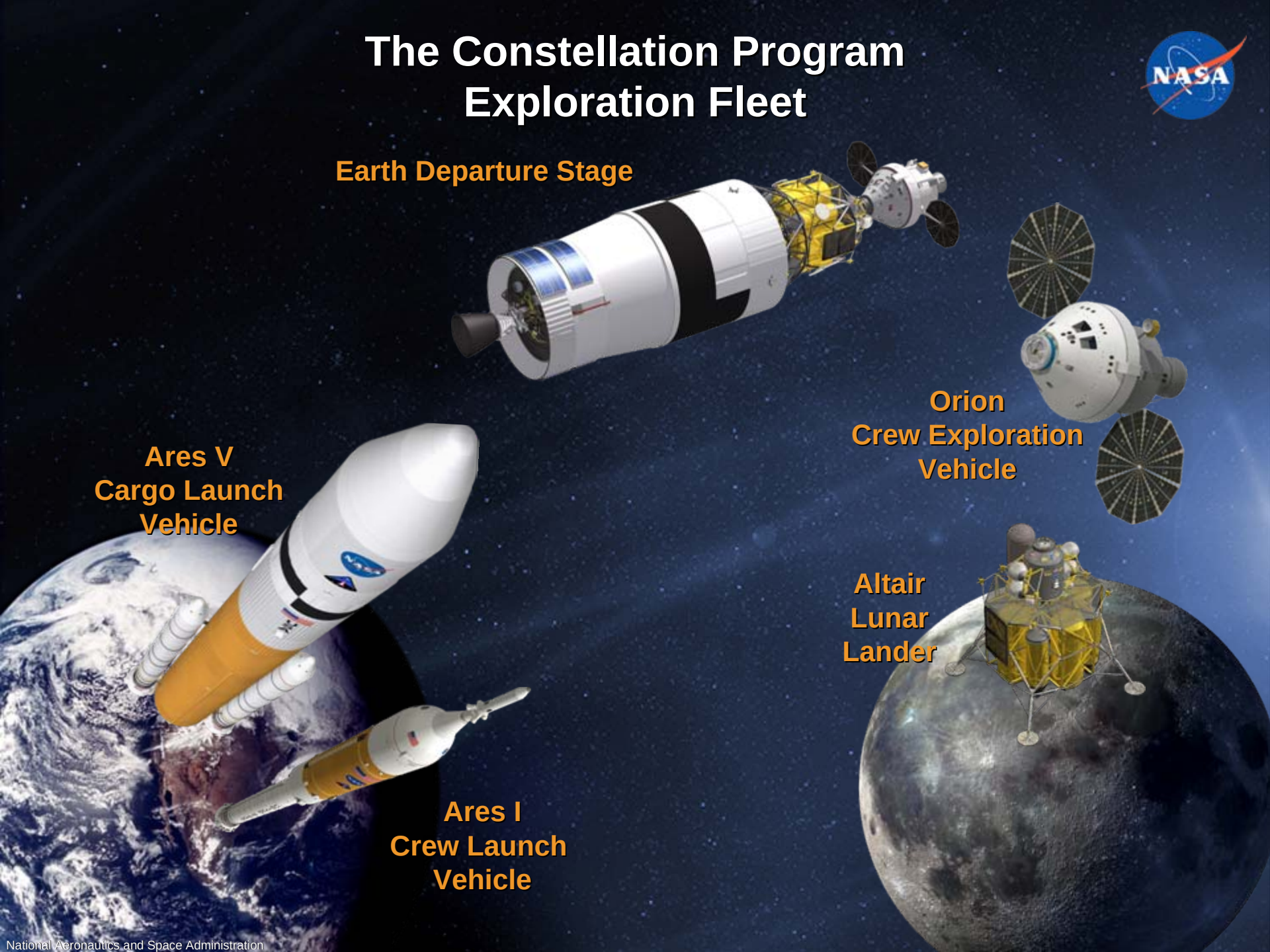
"The next steps in returning to the Moon and moving onward to Mars, the near-Earth asteroids, and beyond, are crucial in deciding the course of future space exploration. We must understand that these steps are incremental, cumulative, and incredibly powerful in their ultimate effect."

– NASA Administrator Michael Griffin
October 24, 2006

Ares Projects Design Considerations

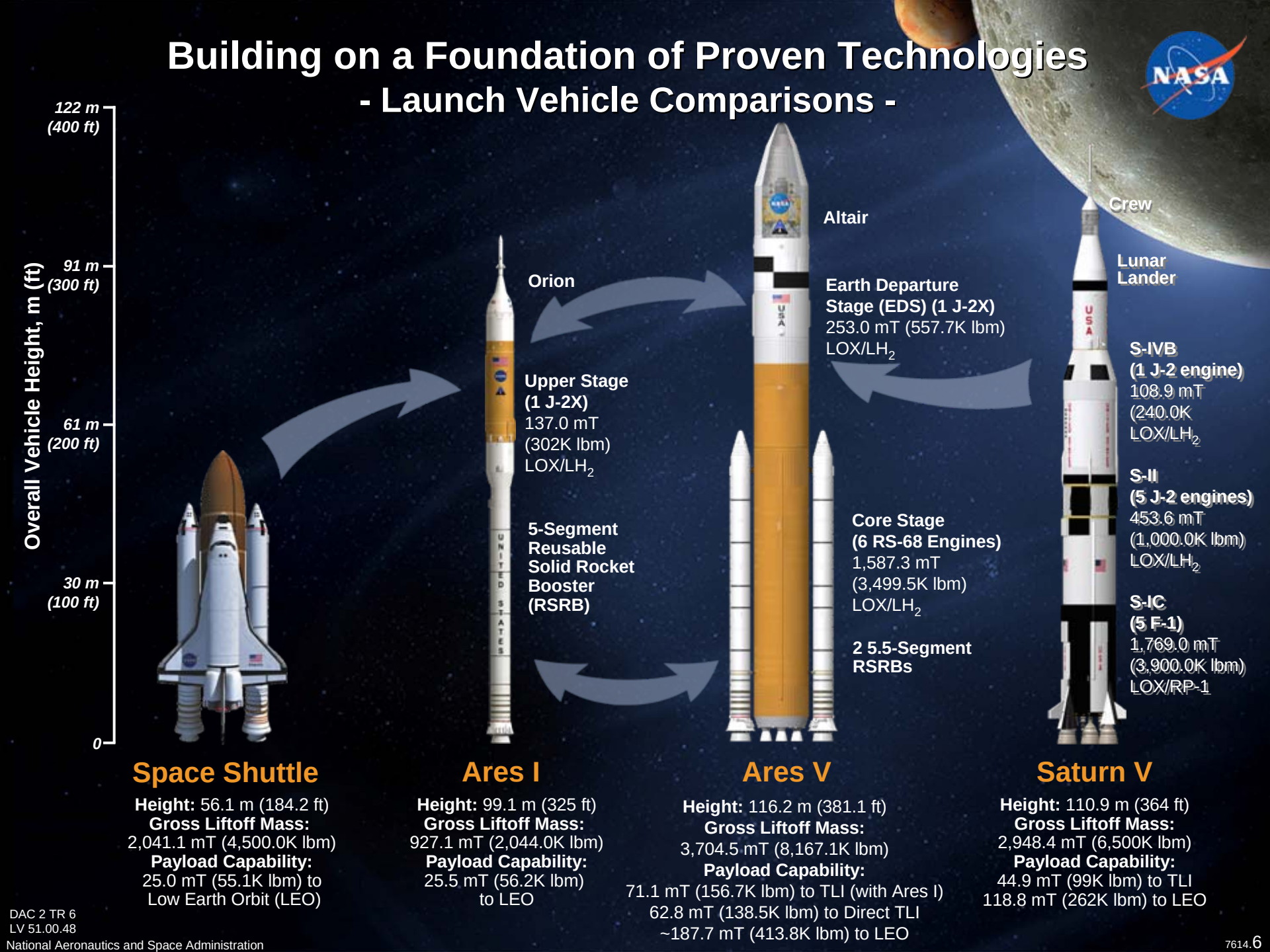
- **Assume little to no "new money" for development**
  - Funding for heavy-lift development not available until Shuttle retirement
- **Use reliable, proven heritage systems and infrastructure**
  - Vehicle systems
  - Manufacturing processes
  - Experienced personnel
- **Incorporate new technologies as needed, appropriate, or affordable**
- **Separate crew from cargo**
- **Use a single "stick" configuration for the Ares I crew launch vehicle**
  - Crew on top instead of on the side of the launch vehicle
- **Design in a crew escape system for increased safety**

The Constellation Program Exploration Fleet



National Aeronautics and Space Administration

Building on a Foundation of Proven Technologies
- Launch Vehicle Comparisons -



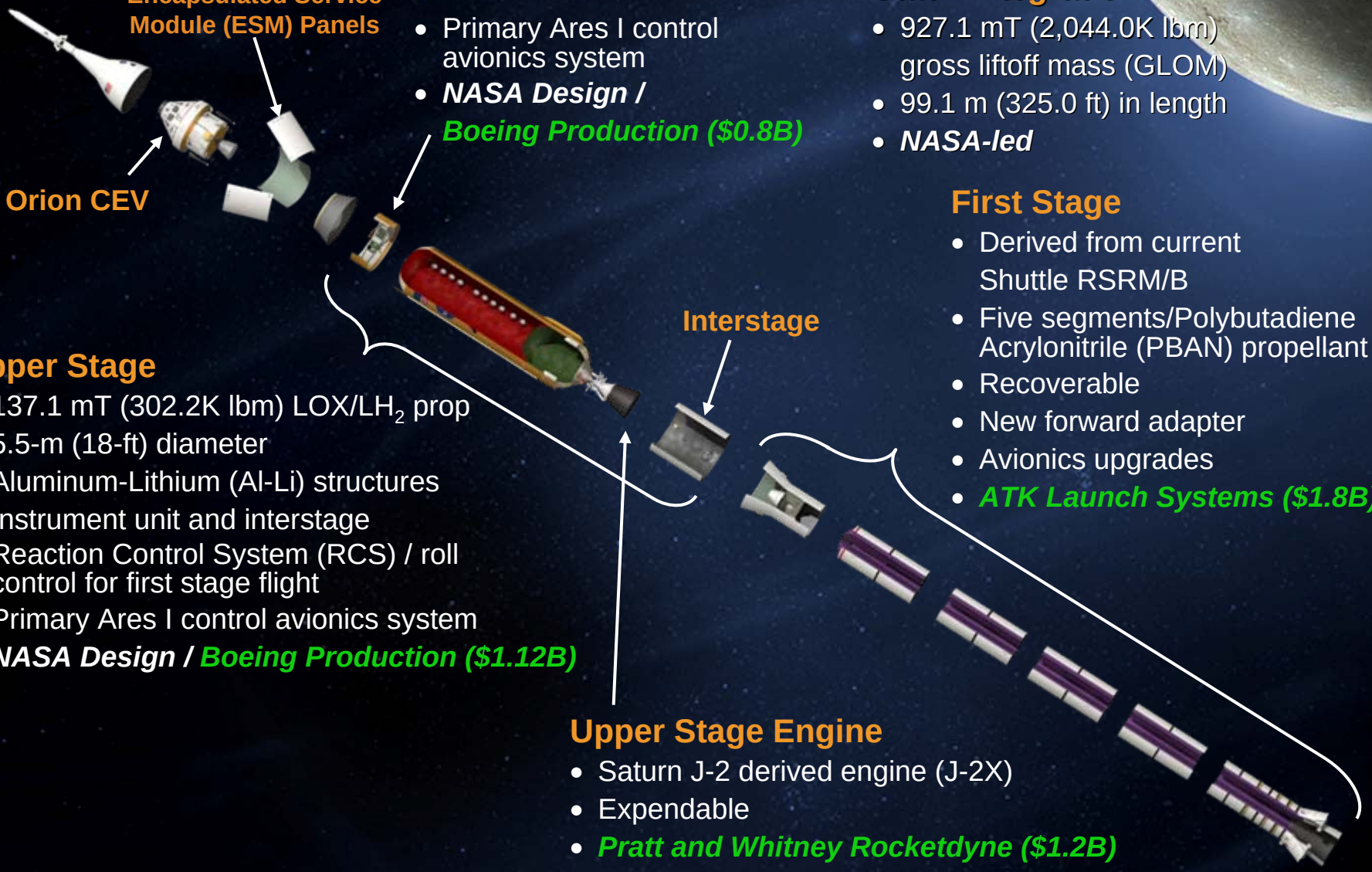
Space Shuttle
Height: 56.1 m (184.2 ft)
Gross Liftoff Mass:
2,041.1 mT (4,500.0K lbm)
Payload Capability:
25.0 mT (55.1K lbm) to
Low Earth Orbit (LEO)

Ares I
Height: 99.1 m (325 ft)
Gross Liftoff Mass:
927.1 mT (2,044.0K lbm)
Payload Capability:
25.5 mT (56.2K lbm)
to LEO

Ares V
Height: 116.2 m (381.1 ft)
Gross Liftoff Mass:
3,704.5 mT (8,167.1K lbm)
Payload Capability:
71.1 mT (156.7K lbm) to TLI (with Ares I)
62.8 mT (138.5K lbm) to Direct TLI
~187.7 mT (413.8K lbm) to LEO

Saturn V
Height: 110.9 m (364 ft)
Gross Liftoff Mass:
2,948.4 mT (6,500K lbm)
Payload Capability:
44.9 mT (99K lbm) to TLI
118.8 mT (262K lbm) to LEO

Ares I Elements



Instrument Unit

- Primary Ares I control avionics system
- ***NASA Design / Boeing Production ($0.8B)***

Stack Integration

- 927.1 mT (2,044.0K lbm) gross liftoff mass (GLOM)
- 99.1 m (325.0 ft) in length
- ***NASA-led***

First Stage

- Derived from current Shuttle RSRM/B
- Five segments/Polybutadiene Acrylonitrile (PBAN) propellant
- Recoverable
- New forward adapter
- Avionics upgrades
- ***ATK Launch Systems ($1.8B)***

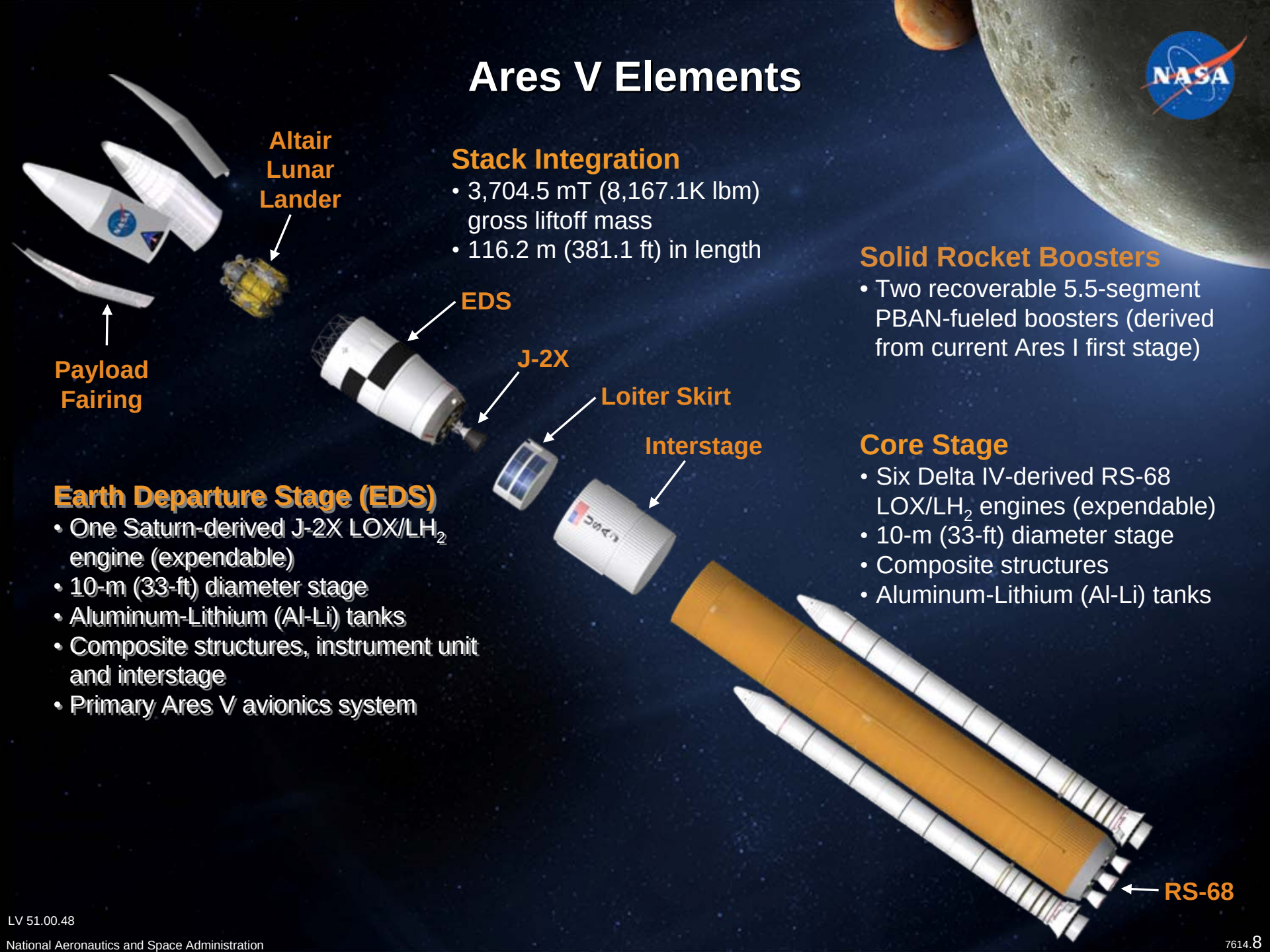
Upper Stage

- 137.1 mT (302.2K lbm) LOX/LH_2 prop
- 5.5-m (18-ft) diameter
- Aluminum-Lithium (Al-Li) structures
- Instrument unit and interstage
- Reaction Control System (RCS) / roll control for first stage flight
- Primary Ares I control avionics system
- ***NASA Design / Boeing Production ($1.12B)***

Upper Stage Engine

- Saturn J-2 derived engine (J-2X)
- Expendable
- ***Pratt and Whitney Rocketdyne ($1.2B)***

Ares V Elements



Stack Integration

- 3,704.5 mT (8,167.1K lbm) gross liftoff mass
- 116.2 m (381.1 ft) in length

Solid Rocket Boosters

- Two recoverable 5.5-segment PBAN-fueled boosters (derived from current Ares I first stage)

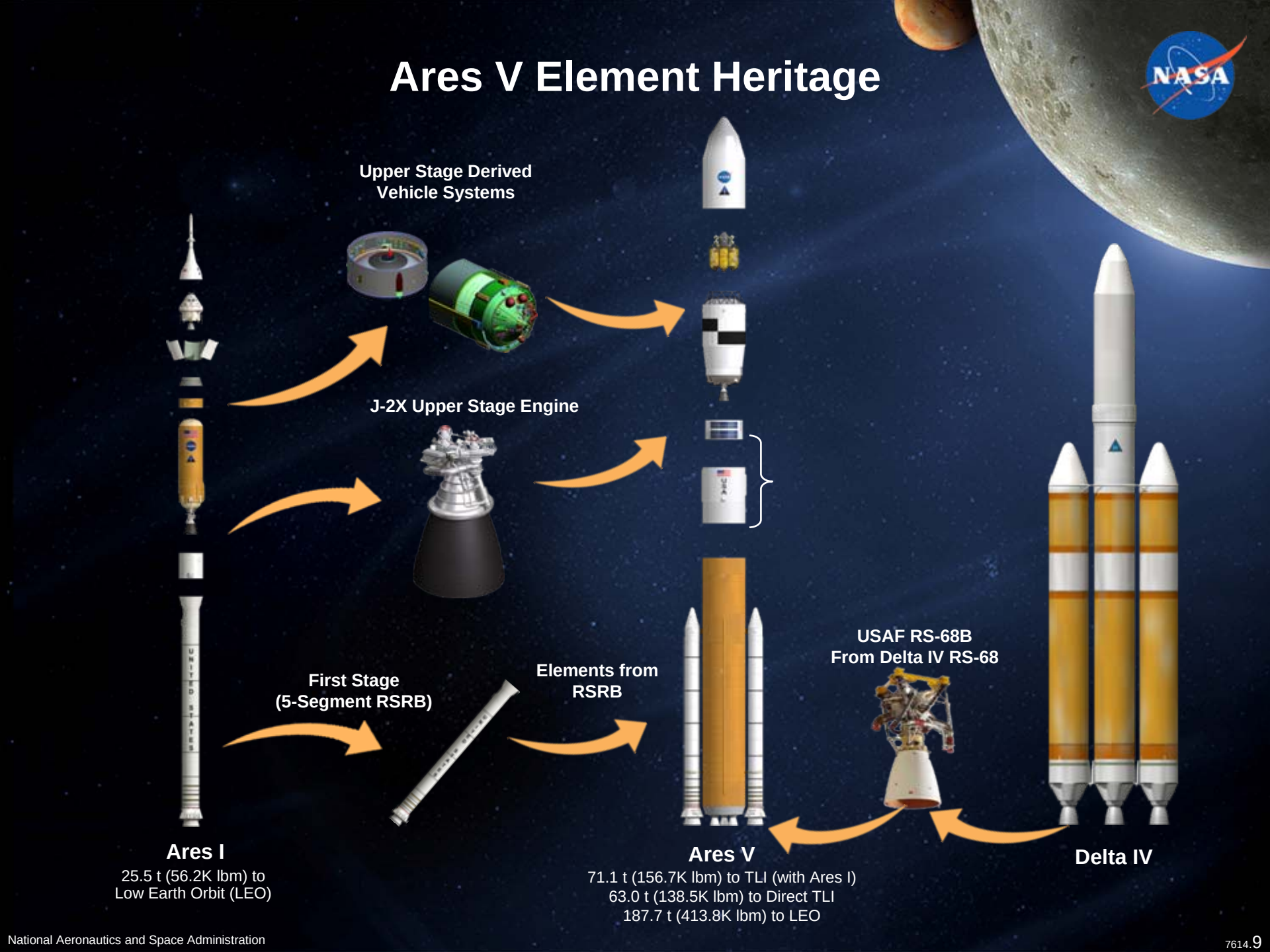
Earth Departure Stage (EDS)

- One Saturn-derived J-2X LOX/LH_2 engine (expendable)
- 10-m (33-ft) diameter stage
- Aluminum-Lithium (Al-Li) tanks
- Composite structures, instrument unit and interstage
- Primary Ares V avionics system

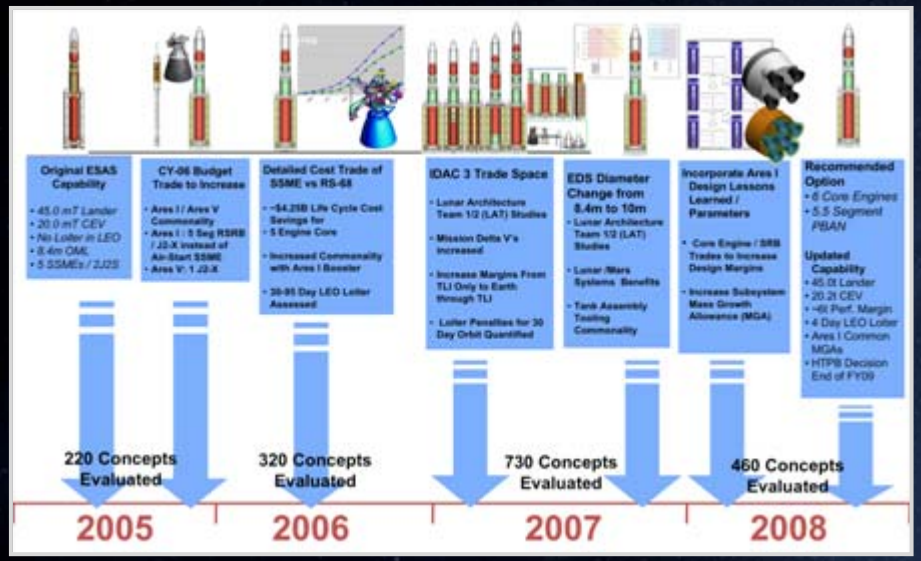
Core Stage

- Six Delta IV-derived RS-68 LOX/LH_2 engines (expendable)
- 10-m (33-ft) diameter stage
- Composite structures
- Aluminum-Lithium (Al-Li) tanks

Ares V Element Heritage



Ares V Utilization Studies

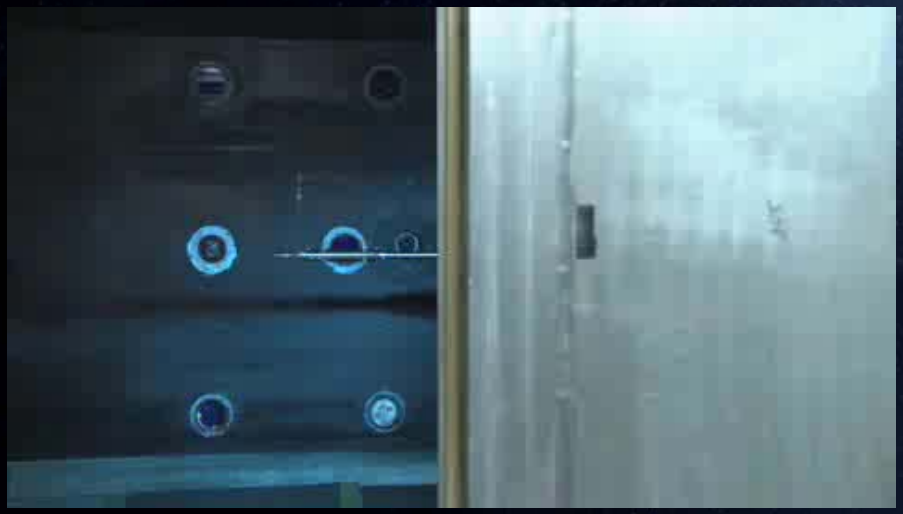


- NASA has begun preliminary concept work on vehicle
- Focused on design of EDS, payload shroud, core stage, and RS-68 core stage engines
- Recent point-of-departure updated for additional performance margin using an additional RS-68 and an added 1/2 segment on the first stage
- Shroud size dictated by eventual size of Altair lunar lander
- Also investigating alternate uses for Ares V not related to human space exploration
  - Very large (8-meter aperture) science telescopes in low-Earth or Lagrange (L2) orbits
  - Capabilities could exceed Hubble by an order of magnitude

Vehicle Integration Accomplishments

Ares PDR Complete

Ares 4% Model Aeroacoustices Wind Tunnel Test
Ames research Center, CA



Ares 1% Model Transonic Wind Tunnel Test
Langley Research Center, VA

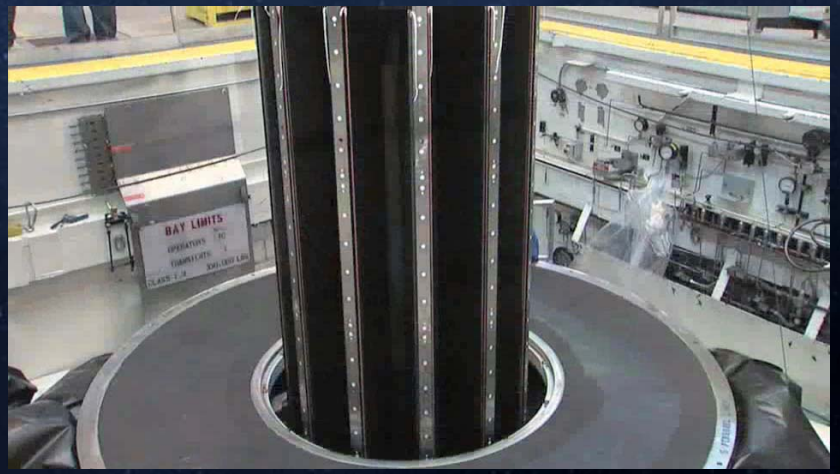
Dynamic Test Stand Renovations
Marshall Space Flight Center, AL

First Stage Accomplishments

First Stage DM-1 Nozzle Fabrication
Promontory, UT

First Stage Fin Installation and Removal Testing
Promontory,UT

First Stage Forward Segment Propellant Casting
Promontory, UT

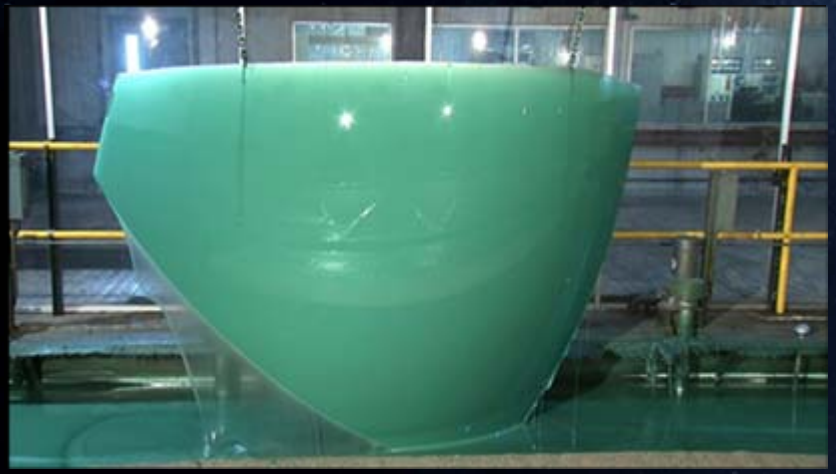


First Stage Forward Core Fin Removal
Promontory, UT

Upper Stage Accomplishments

DELMIA Simulation of Interstage Mock-Up
Marshall Space Flight Center, AL

MPTA Manufacturing Process with DELMIA Simulation Overlays
Marshall Space Flight Center, AL



Dome Gore Panel Chemical Milling
Los Angeles, CA

First FSW Demonstration Weld of Dome Gore Panels
Marshall Space Flight Center, AL

Upper Stage Engine Accomplishments

J-2X Powerpack Removal from A-1 Test Stand
Stennis Space Center, MS

J-2X Workhorse Gas Generator Manufacturing
Canoga Park, CA

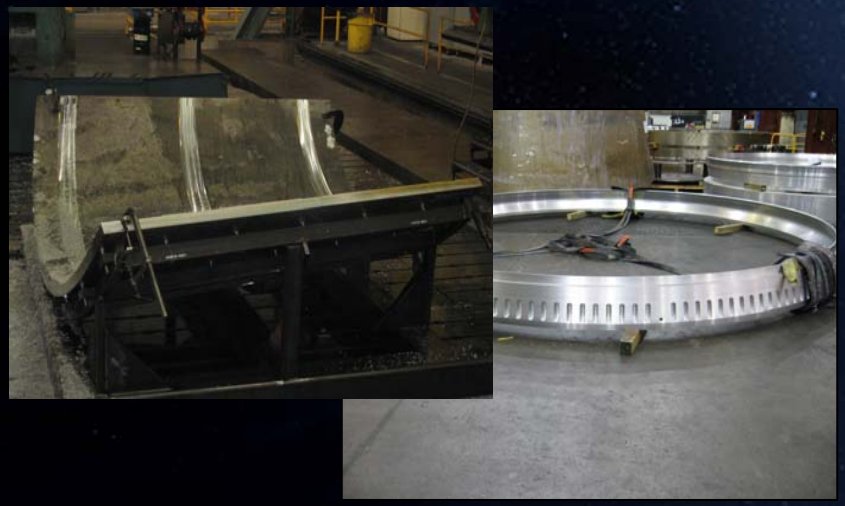
J-2X Powerpack 1A Testing
Stennis Space Center, MS

E3 Subscale Diffuser Test
Stennis Space Center, MS

Ares I-X Accomplishments

Upper Stage Simulator Assembly
Glenn Research Center (GRC), OH

Roll Control System Test and Fabrication
Huntsville, AL and WSTF, NM



Forward Frustum Fabrication
Indianapolis, IN

First Stage Actuator Systems Testing
Marshall Space Flight Center, AL

Ares I-X Test Flight

- **First Ares I flight test (uncrewed)**
- **Will demonstrate ascent, separation, roll control, recovery, and ground capabilities**
- **Uses off-the-shelf, active, and simulator hardware**
  - First stage propulsion, avionics, and roll control active systems
  - First stage forward structures, upper stage, Orion crew exploration vehicle, and Launch Abort System (LAS) instrumented mass simulator hardware
- **Holding flight hardware deliveries to April 2009 launch date**
- **Launch date could be delayed due to availability of Mobile Launcher**

Ares I-X Test Flight

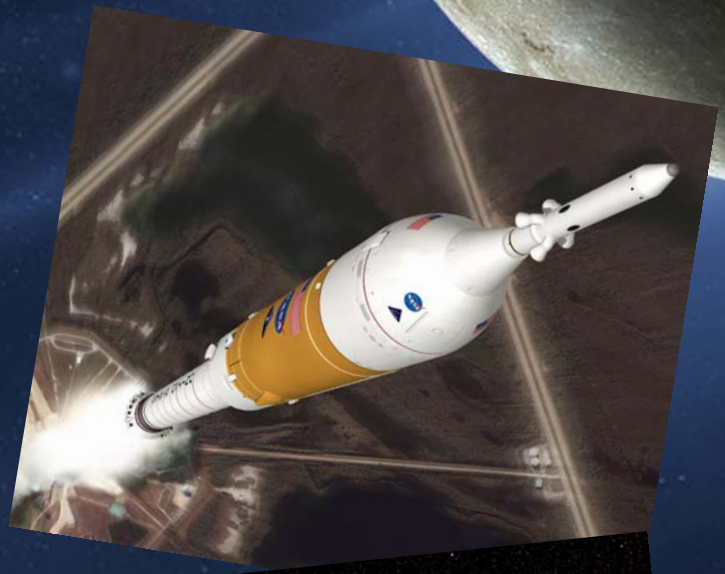
- **Demonstrate and collect key data to inform the Ares I design:**
  - Vehicle integration, assembly, and KSC launch operations
  - Staging/separation
  - Roll and overall vehicle control
  - Aerodynamics and vehicle loads
  - First stage entry dynamics for recovery

- **Performance Data:**

	Ares I-X	Ares I
First Stage Max. Thrust (vacuum):	14.1 MN	15.8 MN
Max. Speed:	Mach 4.7	Mach 5.84
Staging Altitude:	39,600 m	57,700 m
Liftoff Weight:	816 mT	927 mT
Length:	99.7 m	99.1 m
Max. Acceleration:	2.46 g	3.79 g

Summary

- **The Constellation Program renews the nation's commitment to human space exploration**
  - Access to ISS
  - Human explorers to the Moon and beyond
  - Large telescopes and other hardware to LEO
- **Hardware is being built today**
- **Development made easier by applying lessons learned from 50 years of spaceflight experience**
- **Ares V heavy-lift capability will be a strategic asset for the nation**
- **Constellation provides a means for world leadership through inspiration and strategic capability**



www.nasa.gov/ares